ORIGINAL CONTRIBUTION

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Mechanical endonasal dacryocystorhinostomy - a reproducible technique*

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SUMMARY

Background: *A study to assess the efficacy and patient acceptability of Mechanical Endonasal Dacryocystorhinostomy (MENDCR) in patients with acquired nasolacrimal duct obstruction.*

Methods: *A retrospective series of 38 patients undergoing 37 primary and 7 revision MENDCR's between March 2003 and October 2007. Patients included had symptomatic epiphora with anatomical obstruction on syringing or functional obstruction on scintillography. Short-term follow up was assessed subjectively and objectively by anatomical patency on nasendoscopy and free flow of fluorescein from eye to nose. Medium term follow up was assessed subjectively by telephone conversation with the patient. The average follow up period was 25.2 months (range 7–50).*

Results: *There were 44 DCR's performed on 38 patients (12 male, 26 female). Average patient age was 67.0 years (range 16.6–97.5). Almost all patients (95%) presented with epiphora, and a further 34% with dacryocystitis and/or mucocele. At short term follow up 40/44 (91%) were successful objectively. Of two that failed, neither had a patent ostium and one had recurrent mucocele. Both went on to revision surgery, which was successful at later review. A further two had visible ostia but no free flow of fluorescein. At long term follow up 90% were happy with the procedure and would undergo surgery again. All failures occurred by 3-month follow up.*

Conclusion: *The technique of MENDCR is a reproducible technique with results comparable to the original authors. MENDCR is an acceptable alternative to external DCR. It is well tolerated by patients most of whom were satisfied and would undergo the same procedure again.*

Key words: mechanical endonasal dacryocystorhinostomy, external dacryocystorhinostomy, epiphora, dacryocystitis, mucocele, ostium patency

INTRODUCTION

Dacryocystorhinostomy (DCR) is an operation performed for the treatment of nasolacrimal duct obstruction. It was initially described as an endonasal procedure by Caldwell [(1)] in 1893. Due to the technical inadequacies of equipment at that time an external procedure was described 11 years later by Toti [(2)]. This has undergone a number of refinements over the years and is considered the gold standard operation with success rates of more than 90% reported in the literature [(3-5)].

The first modern day endonasal approach was described in 1989 by McDonogh and Meiring. A number of techniques for exposure of the sac have been reported including cold steel with or without powered drills and lasers (Argon, KTP, CO_2) [(6,7)] used endonasally or transcanallicularly. Up until now, with these varied techniques, results from endonasal DCR have been inconsistent (56 to 96%) [(8,9)]. The mechanical endonasal powered DCR as described by Wormald [(10)] proposes excellent results approaching those of conventional external DCR techniques.

The initial description of McDonogh and Meiring's modern technique set the trend of nasolacrimal duct exposure with the anatomical location described anteriorly behind the frontal process of the maxilla and posteriorly behind the lacrimal bone. In all cases exposure of the sac has been recommended from the axilla of the middle turbinate superiorly down to the top of the inferior turbinate [(11)].

Recently it has been demonstrated that the nasolacrimal duct does not lie in the position previously described, but a significant proportion of it is situated above the axilla of the middle turbinate [(12)]. Through a series of CT Dacryocystograms it was established that the lacrimal sac lay 8.8 mm above and 4.2 mm below the axilla. It is believed that current techniques were only opening the lower portion of the lacrimal sac, and thereby accounting for the higher failure rates.

Wormald [(10)] proposed a new technique of powered endonasal DCR later coined "Mechanical Endonasal DCR (MENDCR) with mucosal flaps" [(13)]. With an improved understanding of

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the anatomy, results equalling that of the external approach were reported. The key points in technique were the creation of a large nasal ostium and opening the entire length of the lacrimal sac such that the entire sac was marsupialised and lay open like the pages of a book. Powered instrumentation is used to remove the thick bone from the frontal process of the maxilla and the exposure is continued above and anterior to the middle turbinate. The sac is opened with a sharp DCR blade with accurate apposition of nasal mucosa to the opened lacrimal sac. Ideally the large sac opening should allow direct inspection of the common cannaliculus opening.

There have been no reports of the validity of MENDCR as a surgical technique in the treatment of acquired epiphora other than that of the original authors. We performed our study in order to assess whether MENDCR was an effective and reproducible technique and furthermore assessed patient acceptability of the procedure. We report a series of patients who have undergone this technique with both short and medium term results.

MATERIALS AND METHODS

Design

A retrospective series of consecutive patients who underwent primary and revision DCR were included in the study between March 2003 and July 2007. The details of these patients were collated in a computer database. All patients were reviewed in a joint Otorhinolaryngology - Ophthalmology Lacrimal Clinic. On initial assessment all patients included had anatomical obstruction on syringing or functional obstruction on scintillography. There were 38 patients (12 male and 26 female) who underwent 37 primary and 7 revision procedures (5/7 had their primary surgery in a different unit). Sixteen patients had a left DCR, twenty a right and four bilateral. Mean age was 67.0 years (range 16.6–97.5)

Table 1. Key points in surgical technique.

Septoplasty required in up to 50% of cases
Mucosal incision on lateral nasal wall and creation of posterior based flap
Thin lacrimal bone elevated and inferior portion of frontal process of maxilla removed with Hajek-Kofler punch
Powered drill equipment (diamond tipped DCR burr) required to drill out superior portion of maxilla
Full exposure of the lacrimal sac including fundus of sac
Routine exposure of agger nasi cell (if present)
Sharp dissection to open lacrimal sac with DCR sickle knife
Apposition of lacrimal sac mucosa with nasal mucosa leading to healing by primary intention
Superior and inferior flap replaced
Insertion of O'Donoghue tubes

Table 2. Standard questions asked at telephone interview.

What were your symptoms before surgery?
What were your symptoms after surgery?
Are your symptoms Better/Same/Worse?
Would you have the operation again?

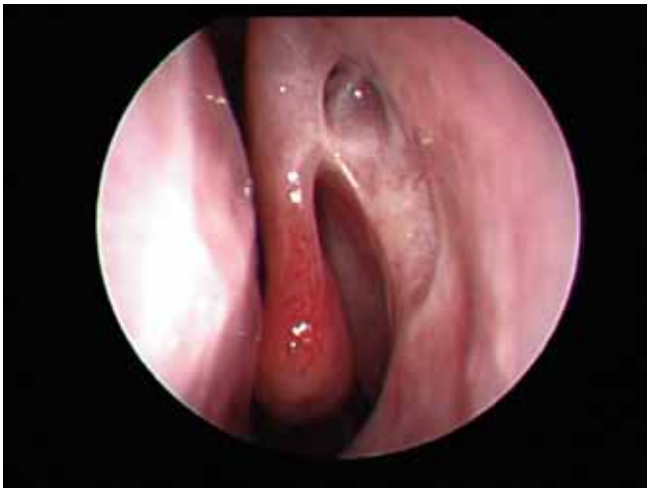

Figure 1. Left DCR site demonstrating a well healed, marsupialised ostium.

Procedure

At the time of operation the intranasal anatomy was assessed and if surgical access limited by a septal deviation then a limited endoscopic septoplasty was performed. A degree of septal deviation is extremely common and in our assessment if we cannot clearly visualise the axilla of the middle turbinate we would routinely perform an endoscopic access resection, rather than a formal septoplasty. This occurred in at least 50% of cases. The technique for MENDCR is as described by Tsirbs and Wormald [13] and points of note in the surgical technique are described in Table 1. All procedures were performed or supervised by the senior author (SN).

Follow-up

Initial follow up was at 6 weeks postoperatively. After removing O'Donoghue tubes under direct vision, objective success was determined by visualising a well-healed marsupialised ostium (Figure 1) and noting the free flow of fluoroscein from eye to nose (Figure 2). Subjective success was reported by the improvement of patient symptoms. Unlike many other studies, the operation was only deemed a success if both objective and subjective criteria were met.

Medium term follow-up was by telephone interview with the patient. Mean length of follow-up was 25.2 months (range 7-50). Table 2 demonstrates the standard questions asked at interview, and this aimed to ascertain subjective success and patient acceptability of the procedure.

RESULTS

At initial follow-up a well healed ostium was seen in 42 out of 44 cases (95%). Postoperative scarring had stenosed one ostium and in another it was partly obstructed by a mucopyocele. In both cases there was no flow of fluoroscein into the middle

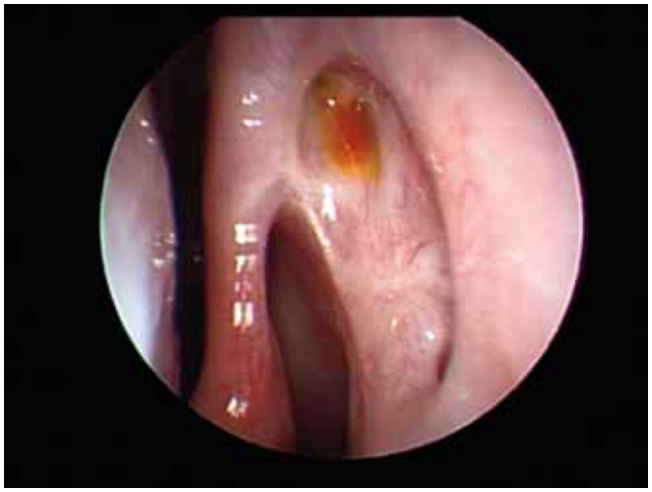

Figure 2. Left DCR site demonstrating fluoroscein flow through the ostium after instillation of a drop into the eye.

meatus after a drop instilled into the eye and symptoms had not improved. Both failures were following primary DCR and underwent successful revision surgery. In a further two cases there was a well healed ostium, but no flow of fluoroscein. Both of these cases, however, reported symptomatic improvement. This gave an overall success rate of 40 of 44 (91%). Table 3 summarises the results following surgery. There were no patients lost to follow-up.

Two patients had complications; one suffered a postoperative secondary haemorrhage that was treated conservatively with Merocel® (Medtronic Xomed, Jacksonville, FL) nasal packing. The patient did not require further treatment and was discharged two days later. In another case there was a postoperative infection that was treated with intravenous antibiotics, which also settled acutely. This patient's symptoms persisted with a recurrent mucopyocele and required further surgery. On medium-term follow up one patient noted that although her symptoms had completely resolved, she complained of air blowing up through into her eye when she blew her nose as a result of air passing through the naso-lacrimal ostium.

Table 3. Results following surgery (n=44).

Subjective success	42 (95%)
Objective success	
Patency of nasal ostium	42 (95%)
Free flow of fluoroscein	40 (91%)
Overall success	40 (91%)

Table 4. Results of telephone interview (n=38).

	Better	Same	Worse
3. Symptoms	36 (95%)	2 (5%)	0 (0%)
	Yes	**Don't Know**	**No**
4. Would you have the operation again?	34 (90%)	2 (5%)	2 (5%)

The results of telephone follow up can be seen in Table 4. Thirty-six of the thirty-eight (95%) patients reported a subjective improvement in their symptoms. The two who did not note an improvement believed their symptoms to be the same as before. In no cases were symptoms worsened by the procedure.

Patient acceptability of the procedure was high (34/38, 90%), and only two would not have the procedure again. This was due to failure of their initial procedure and the need for revision surgery, even though their revision surgery was successful both objectively and subjectively.

DISCUSSION

The traditional operative treatment for adult nasolacrimal duct obstruction has been External DCR (EXT-DCR). Although initially described by Caldwell [1] in 1893 as an endonasal technique, limitations with the equipment at that time led to the abandonment of the procedure after Toti described the first external DCR 11 years later [2]. This developed into the gold standard technique, traditionally performed by ophthalmologists with success rates reported as high as 93% to 95% [3-5].

After improvements with camera equipment and instruments, the first modern endonasal DCR was described by McDonogh [11] in 1989. This technique used cold steel to puncture the nasolacrimal duct directly through the thin lacrimal bone and a guillotine to remove maxillary bone. The boundaries for dissection were the axilla of the middle turbinate superiorly to the top of the inferior turbinate. Endonasal DCR had the theoretical advantages of approaching the lacrimal sac from the nasal side, thereby avoiding the traditional risks of an external wound and disruption of the lacrimal pump.

Comparison with Modern Day DCR Techniques

Since then a number of modifications have been proposed including the use of powered and laser equipment. Current techniques can be separated into Traditional Cold Steel Endonasal DCR (EN-DCR) [14], Endonasal Laser DCR (ENL-DCR) [6,7], Modified Cold Steel Endonasal DCR and Mechanical Endonasal DCR with Mucosal Flaps [13].

Traditional Cold Steel DCR

Success rates following traditional cold steel EN-DCR have been variable. A prospective randomised controlled trial comparing external and endonasal DCR by Hartikainen et al. [15] demonstrated success rates of 91% and 75% respectively. Although not statistically significant the results indicated at the time that external DCR was still the superior technique. No other randomised trials have been identified but a number comparative series' have been reported with differing outcomes and these are summarised in Table 5. As early as 1994, a series was reported by Weidenbecher [17] who performed a cold steel DCR on 56 patients with an extremely high success

Table 5. Results of External, Endonasal DCR (EN-DCR), Endolaser DCR (EL-DCR) and Mechanical Endonasal DCR (MENDCR).

Study	No. of Patients	Technique	Success (%)
Hartikainen et al. [15]	32	External	91
Cokkeser et al. [16]	79	External	89.8
Hartikainen et al. [15]	32	EN-DCR	75
Weidenbecher et al. [17]	56	EN-DCR	95
Sprekelson et al. [9]	152	EN-DCR	85.5
Cokkeser et al. [16]	36	EN-DCR	88.2
Eloy et al. [18]	28	EN-DCR	89
Moore [20]	36	EN-DCR	83
Yung and Hardman-Lea [21]	191	EN-DCR	89
Fayet [22]	100	EN-DCR	86
Onerci [23]	108	EN-DCR (experienced)	94
Onerci [23]	50	En-DCR (inexperienced)	58
Hartikainen et al. [19]	32	EL-DCR	63
Umpathy [8]	65	EL-DCR	56
Moore [20]	31	EL-DCR	71
Mirza et al. [24]	76	EL-DCR	64
Massegur et al. [26]	96	EN-DCR (Chisel)	92
Massegur et al. [26]	40	EN-DCR (Kerrison)	87
Tsirbas and Wormald [13]	105	MENDCR	95
Tan et al.	44	MENDCR	91

rate of 95% as determined by complete or partial resolution of symptoms. Other early series were not able to produce quite as impressive results. Sprekelsen et al. [9] reported a series of 152 endonasal DCR's with a success rate of 85.5% determined by a subjective outcome described as "very good". Cokkeser et al. [16] described a comparative study of 79 external and 51 endonasal DCR's with success rates of 89.8% and 88.2% respectively. Eloy et al. [18] reported 28 cases of endonasal DCR in which 23 (89%) were free from epiphora or much improved at postoperative review. Fayet [22] performed DCR with uncinectomy in 100 patients using a 3.2 mm protected drill bit (Medtronic Xomed) to remove bone from the maxillary bone. However, in only 68% of cases as reported by the authors, was this particular drill bit suitable and tough enough to drill enough bone. Nevertheless the results were good with 86% free of symptoms, and of those 98% had a patent intranasal ostium. In those that failed there was no patency of the nasolacrimal pathways. Onerci [23] reported an interesting study comparing experienced with inexperienced surgeons performing DCR. The success rates between the two groups of 108 and 50 patients respectively were 94.4% and 58% indicating that excellent results are obtainable with cold steel, however there is an appreciable learning curve.

Endolaser DCR

Endonasal Laser DCR has not been shown to be as efficacious as external DCR. Another randomised controlled trial by Hartikainen et al. [19] comparing external and endonasal laser DCR gave success rates of 91% and 63% respectively with a statistically significant difference in outcome noted. Further studies have confirmed this result with results ranging from 56% to 71% [8,20].

Improved anatomical understanding

An updated appreciation of the surgical anatomy has led to a new surgical approach. Anatomical studies [12] have demonstrated that the lacrimal sac does not lie in the position previously thought. Using a series of CT Dacryocystographs, the lacrimal sac was identified to lie 8.8 mm above and 4.1 mm below the insertion of the middle turbinate with a significant part above the entry point of the common cannaliculus. Thus, much of the sac lies behind the frontal process of the maxilla. This improved understanding of the lacrimal sac anatomy has led to an endonasal approach that aims to reproduce the exposure achieved with the external approach. In addition the apposition of mucosal flaps allows mucosal healing by primary intention akin to suturing in the external approach.

Mechanical Endonasal DCR

The technique of MENDCR [13] has reported results that are comparable to the external procedure at medium term follow-up. The success rate to both subjective and objective criteria was 89%, with an anatomical patency of the ostium of 85%. Advantages of this technique include creation of a large nasal ostium by opening the entire length of the sac. It is necessary to use powered drill equipment and by using a diamond tipped burr it is possible to remove enough bone and expose the sac in its entirety. The high-speed 2.5 mm 20 degree angled diamond burr (Medtronic Xomed) is less traumatic if the burr head comes into contact with the surface of the sac. The creation of a large mucosal flap which can be trimmed to size in order to cover the exposed bone and sac allows for accurate apposition of nasal mucosa to lacrimal sac mucosa and thus creates a well marsupialised ostium with a decreased risk of stenosis.

The MENDCR is different from the standard and modified cold steel technique in using a high speed burr to access the fundus of the sac. We have found using rongeurs difficult to engage in this region where access is tight. We think that it is crucial to have the sac exposed at this point so that a complete marsupialisation is achieved. If other authors can achieve this with cold steel (chisels and rongeurs) that is commendable but the principles for success are the same. Our study has demonstrated excellent short and medium-term results with this technique in the management of acquired epiphora matching that of the original authors and equalling that of the external approach. Our study also confirms that of Jin [25] who similarly used a high speed diamond burr to remove maxillary bone

reporting success rates of 83% after primary and 96% after revision surgery indicating that use of drills is becoming routine in standard practice.

Modified Cold Steel Endonasal DCR

Other modified endonasal techniques have been suggested. Massegur et al. [26] compared two cold steel methods of bone removal; in the first group of 96 endonasal DCR's a 4 mm curved Cottle chisel was used to remove the frontal process of maxilla from 2 to 3 mm anterior to the lacrimal bone extending superiorly to just above the insertion of the middle turbinate and down to the inferior turbinate. The second group of 40 DCR's had bone removal with Smith-Kerrison forceps in addition to an inferior mucosal flap. They reported success rates of 92.7% and 87.5% respectively, although had complications of orbital fat exposure and subsequent eyelid haematoma in 5% and 17.5% within the two groups. We feel that the use of an angled high speed diamond burr allows us to accurately remove bone all the way up to the fundus of the sac with minimal risk of orbital and lacrimal injury.

Ostium Size

Poor outcome in traditional Endonasal DCR is attributed principally to the size of the ostium created. Historically there have been reports [27,28] that believed there to be no significance regarding the size of the ostium but this has been widely disputed. A study using CT Dacryocystography [29] to compare the ostium size in patients who underwent successful and failed DCR's found that in 94% of failures the ostium was less than 15mm in size, as opposed to 60% of successful ones. This statistically significant result gives weight to the belief that ostium size directly affects outcome. Studies have demonstrated that there is a statistically significant shrinkage of the DCR ostium in the first 4 weeks postoperatively but thereafter the ostium size remains stable [30].

In our experience, cold steel techniques are unable to remove enough bone to expose the sac sufficiently using the Hajeck-Kofler punch. The only level I study comparing endonasal and external DCR did not find a statistical significant difference in outcome, however there was a trend demonstrating that external outcomes were better (91% vs 75%). Other series have reported outcomes from cold steel DCR to be comparable to external, although were not tested to statistical significance. Although powered equipment has been used in the past the anatomy was poorly understood, hence inadequate opening of the sac. The use of lasers has demonstrated a high failure rate. This has been principally attributed to the difficulty of the laser to penetrate the thick maxillary bone. Prolonged laser vaporisation of the maxillary bone results in thermal damage to surrounding mucosa and resulting fibrosis of the ostium [31]. The high long-term re-stenosis rate has led some establishments to discontinue use of the laser DCR [8].

MENDCR allows for excellent direct visualisation of the anatomy and has results that are comparable to the gold standard. Guidelines on Endonasal DCR by the United Kingdom National Institute of Clinical and Health Excellence (NICE) [32] suggest a minimum follow-up period of 6 months, and include both subjective and objective symptoms as markers of outcome. We have incorporated these guidelines in the design of our study with a minimum follow-up within our patients of 7 months. In addition, by using symptomatic improvement, ascertained by our structured questionnaire, and objective measures such as ostium patency and fluoroscein dye test, we believe that we have tested the technique thoroughly. This study has proven that the described technique of MENDCR is reproducible with good medium term results and has a high patient acceptability.

CONCLUSION

The technique of MENDCR is a reproducible one with results comparable to the original authors, and to the gold standard external DCR. It is safe to perform with an acceptable learning curve and avoids the risks of the external procedure including ocular complications and external scarring. It can be performed for both primary and revision surgery with equally satisfactory results. The procedure is well tolerated and patient acceptability is high. We would recommend this technique as an acceptable alternative to external DCR and feel that the new gold standard in the treatment of acquired lacrimal obstruction is endonasal DCR.

CONFLICT OF INTEREST

The authors confirm:

1) There was no external source of funding
2) There are no commercial associations that might pose a conflict of interest.

REFERENCES

1. Caldwell GW. Two new operations for obstruction of the nasal duct, with preservation of the canaliculi, and with an incidental description of a new lachrymal probe. Am J Ophthalmol 1983; 10: 189–193.
2. Toti A. Nuovo Metodo conservatore dicura radicale delle suppurazione croniche del sacco lacrimale (dacricistorhinostomia). Clin Moderna (Firenza) 1904; 10: 385.
3. Tarbet KJ, Custer PL. External dacryocystorhinostomy. Surgical success, patient satisfaction, and economic cost. Ophthalmology 1995; 102: 1065-1070.
4. Warren JF, Seiff SR, Kavanagh MC. Long-term results of external dacryocystorhinostomy Ophthalmic Surg Lasers Imaging 2005; 36: 446-450.
5. Dolman PJ. Comparison of external dacryocystorhinostomy with nonlaser endonasal Dacryocystorhinostomy. Ophthalmology 2003; 110: 78-84.
6. Woog JJ, Metson R, Puliafito CA. Holmium:YAG endonasal laser dacryocystorhinostomy. Am J Ophthalmol 1993; 116: 1-10.
7. Hoffmann T, Lackner A, Muellner K, Luxenberger W, Wolf G. Endolacrimal KTP laser-assisted dacryocystorhinostomy. Arch Otolaryngol Head Neck Surg 2003; 129: 329-332.

8. Umapathy N, Kalra S, Skinner DW, Dapling RB. Long-term results of endonasal laser dacryocystorhinostomy. Otolaryngol Head Neck Surg 2006; 135: 81-84.
9. Sprekelsen MB, Barberan MT. Endoscopic dacryocystorhinostomy: surgical technique and results. Laryngoscope 1996; 106: 187-189.
10. Wormald PJ. Powered endoscopic dacryocystorhinostomy. Laryngoscope 2002; 112: 69-72.
11. McDonogh M, Meiring JH. Endoscopic transnasal dacryocystorhinostomy. J Laryngol Otol 1989; 103: 585–587.
12. Wormald PJ, Kew J, Van Hasselt CA. The intranasal anatomy of the naso-lacrimal sac in endoscopic dacryocystorhinostomy. Otol Head Neck Surg 2000; 123: 307–310.
13. Tsirbas A, Wormald PJ. Mechanical endonasal dacryocystorhinostomy with mucosal flaps. Br J Ophthalmol 2003; 87: 43–47.
14. Yung MW, Hardman-Lea S. Endoscopic inferior Dacryocystorhinostomy Clin Otolaryngol Allied Sci 1998; 23: 152-157.
15. Hartikainen J, Antila J, Varpula M, Puukka P, Seppa H, Grenman R. Prospective randomized comparison of endonasal endoscopic dacryocystorhinostomy and external dacryocystorhinostomy. Laryngoscope 1998; 108: 1861-1866.
16. Cokkeser Y, Evereklioglu C, Er H. Comparative external versus endoscopic dacryocystorhinostomy: results in 115 patients (130 eyes). Otolaryngol Head Neck Surg 2000; 123: 488-491.
17. Weidenbecher M, Hosemann W, Buhr W. Endoscopic endonasal dacryocystorhinostomy: results in 56 patients Ann Otol Rhinol Laryngol 1994; 103: 363-367.
18. Eloy P, Bertrand B, Martinez M, Hoebeke M, Watelet JB, Jamart J. Endonasal dacryocystorhinostomy: indications, technique and results. Rhinology 1995; 33: 229-233.
19. Hartikainen J, Grenman R, Puukka P, Seppa H. Prospective randomized comparison of external dacryocystorhinostomy and endonasal laser dacryocystorhinostomy. Ophthalmology 1998; 105: 1106-1113.
20. Moore WM, Bentley CR, Olver JM. Functional and anatomic results after two types of endoscopic endonasal dacryocystorhinostomy: surgical and holmium laser. Ophthalmology 2002; 109: 1575-1582.
21. Yung MW, Hardman-Lea S. Analysis of the results of surgical endoscopic dacryocystorhinostomy: effect of the level of obstruction. Br J Ophthalmol 2002; 86: 792-794.
22. Fayet B, Racy E, Halhal M, Bernard JA, Renard G. Endonasal dacryocystorhinostomy (DCR) with protected drill. J Fr Ophtalmol 2000; 23: 321-326.
23. Onerci M, Orhan M, Ogretmenoğlu O, Irkeç M. Long-term results and reasons for failure of intranasal endoscopic Dacryocystorhinostomy. Acta Otolaryngol 2000; 120: 319-322.
24. Mirza S, Al-Barmani A, Douglas SA, Bearn MA, Robson AK. A retrospective comparison of endonasal KTP laser dacryocystorhinostomy versus external dacryocystorhinostomy. Clin Otolaryngol Allied Sci 2002; 27: 347-351.
25. Jin HR, Yeon JY, Choi MY. Endoscopic dacryocystorhinostomy: creation of a large marsupialized lacrimal sac. J Korean Med Sci 2006; 21: 719-723.
26. Massegur H, Trias E, Ademà JM. Endoscopic dacryocystorhinostomy: modified technique. Otolaryngol Head Neck Surg 2004; 130: 39-46.
27. Bumsted RM, Linberg JV, Anderson RL, Barreras R. External dacryocystorhinostomy. A prospective study comparing the size of the operative and healed ostium. Arch Otolaryngol 1982; 108: 407-410.
28. Linberg JV, Anderson RL, Bumsted RM, Barreras R. Study of intranasal ostium external Dacryocystorhinostomy Arch Ophthalmol 1982; 100: 1758-1762.
29. Gokcek A, Argin MA, Altintas AK. Comparison of failed and successful dacryocystorhinostomy by using computed tomographic dacryocystography findings. Eur J Ophthalmol 2005; 15: 523-529.
30. Mann BS, Wormald PJ. Endoscopic assessment of the dacryocystorhinostomy ostium after endoscopic surgery. Laryngoscope. 2006; 116: 1172-1174.
31. Sadiq SA, Ohrlich S, Jones NS, Downes RN. Endonasal laser dacryocystorhinostomy - medium term results. Br J Ophthalmol 1997; 81: 1089-1092.
32. National Institute of Clinical Excellence. Training Standards for Endonasal DCR. http://www.entuk.org/publications/EndonasalDCR.pdf; 2006.

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